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Multi-service Distributed Training Testbed (MDT2)
Lessons Learned Final Report

Loral Systems Company
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Multi-Service Distributed Training Testbed (MDT2)

Lessons Learned

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1 INTRODUCTION

1.1 BACKGROUND

The Battlefield Distributed Simulation - Developmental (BDS-D) simulation program has demonstrated that man-in-the-loop distributed interactive simulation systems, including an active, intelligent opposing force, can explore the validity of planned hardware configurations as well as the concepts for employment, doctrine, and tactics.

1.2 PURPOSE OF THE MDT2 TRAINING EXERCISE

The objective of the Multi-service Distributed Training Testbed (MDT2) Training Exercise was to demonstrate the capability to conduct meaningful multi-service, combat mission training using Distributed Interactive Simulation (DIS) technologies and synthetic battlefields. The focus for this training demonstration was close air support (CAS). The Multi-Service Distributed Training Testbed linked simulations and simulators of all four Services classified at a SECRET/NOFORN level. Airframe crew simulators of Air Force pilots at Armstrong Labs, Mesa, AZ (formerly Williams AFB, AZ), and Marine and Navy pilots at Systems Engineering Test Directorate, Patuxent River, MD, emulated attack and forward air control aircraft. They supported the conduct of ground force operations by Army elements in Advanced Distributed Simulation vehicles and Tactical Operations Center (TOC) at the Mounted Warfare Test Bed (MWTB), Fort Knox, KY. Additionally, a Marine Deployable Forward Observer (DFO)-MULE (ground laser designator) team participated from NRaD-San Diego, CA, using their target identification simulators. The key to the demonstration were the performance measurement and feedback systems used for the CAS training.

1.3 PURPOSE OF THIS DOCUMENT

This document memorializes the authors' observations of lessons learned during the conduct of the MDT2 demonstration with respect to conducting this sort of BDS-D evolution. It does *not* attempt to evaluate either the effectiveness of training provided to soldiers, airmen and marines during the demonstration or the overall suitability/operational effectiveness of distributed simulation as a medium for delivering CAS training such evaluations are left to the project's sponsor, the Army Research Institute for the Behavioral and Social Sciences (ARI), based on the reports of military participants and the observations of ARI scientists and their support contractor staff. The authors' goal is rather to provide information that will be of use to Simulation, Training and Instrumentation Command (STRICOM) and Loral, the providers of BDS-D services, as well as to future BDS-D customers who may wish to utilize the system in similar demonstrations.

1.4 ORGANIZATION OF THIS DOCUMENT

The remainder of this document is organized into three sections. The first of these lists the issues identified by the authors, discusses each issue, and presents recommendations for solving problems similar to those identified during the conduct of future demonstrations. Next is a discussion of BDS-D exit criteria, that were satisfied, and the degree to which they were demonstrated, during the MDT2 project. A final, summary section lays out some general conclusions drawn from observations of the demonstration and recommendations based on those conclusions.

2 ISSUES, DISCUSSIONS AND RECOMMENDATIONS

2.1 ORGANIZATIONAL

2.1.1 Coordination of Sites/Activities

Issue: The coordination of operations at multiple sites equipped with simulations of differing capabilities and interoperating through experimental interfaces requires the assignment of a senior person in charge who is capable of examining and adjusting both technical, operational, and procedural elements of the demonstration to optimize the probability of success.

Discussion:

The MDT2 demonstration's sponsor, Dr. Moses of ARI, tasked several different agencies to participate, to include:

- STRICOM/Loral for BDS-D support at the Mounted Warfare Test Bed - tasked with providing the ground component simulators (less the USMC MULE team) and Semi-Automated Forces (SAF), the Stealth/AAR (After Action Review) hardware and software capabilities, a Simulation Network (SIMNET)/DIS Protocol Transfer hardware/software suite, and a Defense Simulation Internet (DSI) network interface.
- Armstrong Labs for F16 strike aircraft simulators and DIS network coordination.
- The Naval Air Warfare Center Aircraft Division, Patuxent River for an Airborne Forward Air Controller (AFAC) simulator and provision of a T1 line to link Armstrong Labs to the DSI network.
- The U.S. Army Armor Center, and (through the center) the 194th Separate Armor Brigade and the U.S. Army (Kentucky) National Guard for Observer Controllers and exercise participants.
- The Naval Air Warfare Center, Training Systems Division (NAWC/TSD) and NRaD for a MULE team simulation.
- ARI/ Human Resources Research Organization (HumRRO) for data collection and analysis.
- Jim Love, ARI consultant, for scenario development.
- DCI/Defense Modeling and Simulation Office (DMSO)/Houston Associates to provide access to the DSI net.

(See Appendix B for a list of participants at Ft. Knox.)

The problems encountered during the first week of preparations for the MDT2 exercise involved a great deal of troubleshooting. Problems different in nature and different in location had to be dealt with. There was no single person directing this effort.

The person who developed the MDT2 concept and coordinated the project as a whole prior to this on-site exercise preparation was Dr. Frank Moses of ARI. During the exercise Dr. Moses' role, however, had shifted to that of primarily non-interference and observation. His goal apparently was not to unduly influence the outcome of the exercise. This left the key players, both at Ft. Knox and the other sites, to coordinate and interact with each other, but without overall direction from one source. The result was some confusion.

Col. Don Elder of the Armor Center, (supported by Col. Mike Rodriquez USAF), was designated the chief trainer for the exercise, but he was not familiar with the other sites and had provided no input into the scenario development or simulation organization. He was not given detailed information on the capabilities of the simulators at all four sites. He could not, therefore, optimize the scenarios used in conjunction with the equipment on hand and the designated procedures. He indicated during first week discussions that he saw his mission as taking the hardware, software, communications links and scenario as a given; attempting to train CAS in that milieu; and reporting whether training occurred or not.

Steve Farrow, the LORAL Program Manager (PM) at Ft. Knox seemed to become the de-facto DSI coordinator among the sites (since Armstrong Labs was not plugged directly into the net, but rather connected via T-1 line from Pax River, it was impossible for Herb Bell at Armstrong to monitor the network's health and coordinate the sites). Steve and his staff spent hours on the telephone with Houston Associates - their contact for long haul network problems, only to find that the secure (red) net, however, was still the responsibility of Bolt, Beranek, and Newman (BBN) in Cambridge, but in transition to Houston Associates, so Houston was of little help, at least during the first week.

Recommendation: It is recommended that in projects of this nature and scope, the responsibility of pulling all the bits and pieces together should be given to a senior *operational* person who is familiar with simulation and has the authority to direct any person that can make it work. It is felt that since the focus of this exercise was training, the most suitable candidate for this role would have been Col. Elder. His involvement should have started at the beginning with control of scenario development, personnel assignments, etc. and visits to each site to fully understand the attributes and idiosyncrasies of each simulation system *from an operational point of view* . His mission should have been: "Here is a suite of simulation equipment at these four sites. These are the capabilities and limitations of the equipment. Here are the available troops and contractor support people. The goal is to train CAS. Make it work if at all possible and report results." Given that mission he could have optimized the scenario, identified the important "glitches" in the various simulators that needed fixing, and put in place O/C and troop procedures to fill in for simulation shortcomings where appropriate. In fact, COL Elder and his staff evolved into this role over the course of the demonstration, but had he been so assigned from the outset of the project, many problems would have been avoided and technical efforts to prepare for the demonstration would have been better focused in critical areas.

The person responsible for DSI coordination and liaison should be at a site that is a DSI node.

2.1.2 Coordination of Schedules

Issue: The four sites used in this exercise span three time zones. Schedules for participants at each location must be coordinated to allow for network availability, meal breaks and normal working hours.

Discussion: The schedules planned for this exercise did allow for differences in times zones, and therefore, the actual exercise time is somewhat limited. A time of 11:00 a.m., Eastern Standard Time was set for the start of the exercise. It appeared difficult to get all sites up and ready at this time. Delays due to various reasons occurred causing the start of the exercise close to at the designated lunch break at the Ft. Knox site.

Recommendation: To get the maximum benefit from the limited times available, it is crucial that all preparations be made prior to the official start time and that an earlier start time of 10:00 a.m.. Eastern Time would be preferable. Technical problems should be addressed prior to this time, if possible. Briefings should be completed and personnel should be ready to start tactical play at 10:00.

2.1.3 Assignment and Tasking of Test Subjects

Issue: A determination must be made as to the personnel requirements at each location with respect to their skill level, functions, experience and their role in this exercise.

Discussion: The major personnel tasking issue noticed during this first week of MDT2 was discussed in Section 2.1.1, the lack of one operational person to take charge of the whole exercise. There also seemed to be some areas where additional test subjects were needed. This was particularly true in the TOC. This station was understaffed and staffed only with officers. It also appeared that the pilots at Armstrong were changed frequently and participated for only short periods of time. At the Knox site. the lead technician was moved to Ft. Benning just prior to this exercise, leaving the site understaffed by one.

The original assignment of roles to participating troops was found by the O/Cs to be inappropriate. Since platoon leaders play no role in CAS, dedicating simulators and troops to play these roles was found not to contribute to training.

Although four personnel were requested at NRaD for the MULE, they did not all show up.

Pilots at Armstrong rotated through the exercise, so that seldom were the same pilots used on successive days.

Recommendation: Some of the personnel issues were noted during this first week and some changes were made. Col. Elder recommended having a more representative staff in the TOC. A change in the organization of personnel in the TOC area occurred for the actual exercise.

The availability of simulators and SAF vehicles should be considered early in scenario development and personnel assignments.

Arrangements for backup personnel should made. It is also recommended that the number of different pilots used in this or any exercise of this nature be kept at a minimum. Different players bring in another variable into the exercise. Although in reality new pilots may be brought in for every CAS mission, the limitations and work-arounds necessary in the early versions of this type of training necessitate the use of a stable group of pilots. Since the amount of time pilots can remain in simulators is more limited, two sets of pilots would be acceptable to allow for relief.

2.2 TECHNICAL

2.2.1 Local Simulation Network

There were no significant problems in this area. A couple of simulators crashed but were quickly brought back on line.

2.2.2 DSI Network

2.2.2.1 Protocol Translator

Issue: The translating systems at each site must be capable of transferring Protocol Data Units (PDUs) across the net.

Discussion: Different translating systems were used at the sites in this exercise. Both Armstrong and NRaD used the NIU interface units, Pax used an AIU interface unit and Ft. Knox has the SIMNET DIS Protocol Translator. There were problems in the ability of these various systems to adequately read and translate the PDUs being sent on the DSI net:

- Pax River could not translate the Fire and Detonation PDUs and therefore could not see that their aircraft was being fired at by SAF ZSU 23s (Soviet Air Defense vehicle) at Ft. Knox nor was there any effect if a hit did occur.
- Indirect fire could not be seen at NRaD because it originated from the SAF operator sending detonation PDUs and did not have a source vehicle attached to it. This caused it to come across as a bad packet at NRaD.
- Lases were not translated at Ft. Knox because SIMNET does not have a lase PDU.

Recommendation: Pax River is in the process of revising their AIU interface unit and had they had sufficient preparation time prior to the start of this exercise, most, if not all of these problems could have been eliminated. Sufficient time, not technical capability seem to have caused this problem. These technical issues are still being worked on and the systems will soon be capable of effective protocol transfer. This is also the case at the other sites, however, if a translation problem still exists at the time of future exercises, the impact of this problem must be analyzed and alternative solutions sought.

Although a PDU may not seem to be required at one site vs. another, the ability to process these may often be required to effectively troubleshoot system problems. A case in point is the lasing

PDU. It was impossible for the Chief Trainer, O/C staff and technical staff at Knox to determine why laser-guided bombs fell on a previously lased target rather than the one currently being lased.

2.2.2.2 Sufficient PDU Update Rates/Bandwidth

Issue: the customer (in this case the overall MDT2 project manager) and the supplier of DSI services needs to be able to predict in advance what the network bandwidth requirements will be. No standard way to estimate requirements seems to have been used here..

Discussion: For the bandwidth to be sufficient for an exercise of this nature, other users on the network must be kept to a minimum. The fluctuation in the PDUs transferred across the net vary with the activities of the exercise. Insufficient bandwidth at peak usage may have been one of the factors responsible for repeated down time of the DSI network.

Recommendation: Sufficient testing should be done prior to the execution of an exercise of this nature so as to determine peak bandwidth requirements. A standard method for calculating bandwidth requirements should be developed by the DSI operating agency and provided to potential users. Such a system might require exercise developers to fill out questionnaires listing numbers and types of simulators and voice radio channels, estimates of various types of engagements and simultaneous voice radio messages and the like. DSI schedulers could then translate the information into bandwidth numbers.

2.2.2.3 Reliability/Availability

Issue: The long haul network must be available for the times allocated to this exercise and must be reliable during those periods of time to minimize any disruption of the exercise.

Discussion: During the course of this exercise, one of the key difficulties was the reliability of the DSI network. In some cases it crashed; in others, the exercise was out-prioritized by other network demands, resulting in a less than 70% availability. In addition to the bandwidth problems discussed in Section 2.2.2.2, other technical problems seem to have effected the reliability of the network.

During a post-exercise meeting at Armstrong Labs it was noted that not only was the network not reliable during the rehearsal and test, it was equally unreliable during pre -demonstration testing, forcing the technical team to truncate their system test and check-out procedures. The results were predictable.

Recommendation: DSI reliability is critical to the successful evaluation of the use of simulation across the long-haul network. When unknown technical factors affect the reliability of the network during the course of an exercise, open, administrative communication lines should be available between those individuals who can directly evaluate and fix the problem. [See Appendix C: The attached memo dated May 16, 1994 from Dr. Moses to DMSO after the first week provides a clear statement of the problems with, and concerns about the DSI network.].

Network availability and reliability prior to the demonstration, during the weeks and months of system integration and test, is equally important.

2.2.2.4 MDT2 Network Management

Issue: Management, control and submission of overall network requirements should be with one individual.

Discussion: Herb Bell at Armstrong was assigned to manage the network, yet he was at the one site that was not on the DSI net directly. The center-of-mass of the exercise was at the Knox site, yet there was no direct communications link between Knox and Houston/BBN.

Recommendation; Management of the network activities should be given to one individual at the largest site in the exercise that is a node on the DSI network.. This individual should be involved with the estimations of exercise bandwidth requirements and coordination with Houston Associates. Net requirements should be analyzed with regard to:

- Tactical nets
- O/C- Video Teleconference (VTC) nets
- Administrative/Technical coordination of nets

Determinations should be made with regard to using the DSI net for all communication requirements. In the case of Administrative/Technical communication requirements, a conference call hook-up via AT&T provides a redundant, reliable and practical solution.

2.2.3 Virtual Battlefield

2.2.3.1 Terrain and Natural Environment Correlation

Issue: The terrain displayed at all the sites must sufficiently correlate with respect to its elements, e.g. altitude, texture, color, etc.

Discussion: Different terrain databases (all of the Naval Training Center (NTC)) were used at the different sites in this exercise. Armstrong and Pax used the same database; NRaD's system used a database correlated with a few still photographs; and Ft. Knox had still another database. At times during the course of this exercise, these databases were not matched up properly. Once the problem was identified, there were technical work-around solutions available.

Recommendation: The use of a consistent terrain database between all sites would ameliorate this kind of problem. However this is also interrelated with the different kinds of simulation systems used at each site and the different ways they operate on the database to represent the world. Therefore, correlation tests should be run during exercise preparations by selecting various terrain features and having all stations report the locations and view entities placed at those locations by each of the systems with all appropriate sensors.

2.2.3.2 Granularity of Terrain Database

Issue: The level of detail of the terrain database at each site must be sufficient to support the functions required of each system in this exercise.

Discussion: The terrain database varies at the different sites used in this exercise. This is due to the fact that each terrain was developed specifically for its own system. The visual representation of the terrain that an F16 pilot sees out his window is very different than the terrain seen by the crew of an M1A1. At times, the AFAC was seen at Fort Knox to fly through hills - due to the fact that variations in relief are calculated more densely in the terrain database at Ft. Knox, resulting in a more detailed (albeit more limited in area) terrain definition than that available in the flight simulator databases. Thus, the peaks seen at Ft. Knox may not be seen at Armstrong, and therefore it will appear at Knox as if the planes are flying through hills.

Recommendation: Until such time as the technology allows us to produce consistent levels of granularity in all the terrain databases, this discrepancy will continue to occur. The terrain and tactics chosen in scenarios should try to minimize these differences. The planes should continue to tactically fly as they normally would according to their own visual system.

2.2.3.3 Artifacts of the Simulation

Issue: The virtual battlefield must be free of artifacts that can impose unrealistic constraints or advantages on combatants during the exercise.

Discussion: For the purposes of this exercise, the F16 pilot had to detect and identify the vehicles on the ground. It was discovered that this was not always the case. Ground vehicles were usually visible on the flat terrain but not when they were moving in the hilly areas. The problem may be one of color contrast between the vehicle and the ground as seen on the F16 simulator Computer Image Generator (CIG). The contrast may not be great enough for the planes to detect the targets in the hilly areas.

Recommendation: Detection tests should be performed to see where on the terrain database the ground vehicles are not being seen. The scenarios should be altered slightly to move the ground vehicles to locations where the F16 pilots can realistically detect the targets. It is important to remember that the *only* purpose of the simulation is to provide reasonably realistic cues to stimulate proper solder-to-soldier and soldier-to-airman coordination and control activities.

2.2.4 Moving Models

2.2.4.1 Consistency of Iconic Representation

Issue: The icons used for entities must be clearly representative of their appearance in the real world.

Discussion: Several entities in this exercise were using icons which did not represent what they actually were; the icon used to represent the MULE was a single dismounted soldier; the icon used to represent the OV-10 was an A-10. Both these representations did not appear to cause any problems in the performance of the exercise. There were, however, a few more bizarre mismatches that occurred within specific simulators at the Knox site during the exercise (BMPs (Soviet Armored Personnel Carrier) showing as "beach balls") that caused problems.

Recommendation: The Data Element Dictionary (DED) should be checked in all simulators prior to the exercise. If proper icons are not available at the time, the most reasonable substitutes should be assigned.

2.2.4.2 Limits of Numbers of Moving Models Processed/Displayed (Prioritization)

Issue: The simulation systems used at each site in this exercise have different capabilities with respect to the number of moving models they can process simultaneously. Prioritization of the iconic representations had to be used due to these limitations.

Discussion: Ft. Knox has the capability of representing all the moving models involved in this exercise; however, this is not the case at the other sites participating. The MULE at NRaD is a system that can only display 5 entities on the battlefield and these are prioritized. If an entity with a higher prioritization enters the field, the lower priority vehicle drops off the terrain. The F-16s at Armstrong also have a limited number of entities they can display. The AFAC simulator at Pax River could initially see only the *first* 16 moving models loaded on the database. This limitation caused a major problem in the performance of the AFAC. Prior to the second week of the exercise, however, technicians were able to make some changes in the manner in which the 16 moving models to be displayed were prioritized. The 16 moving models displayed subsequently were those in closest proximity to the AFAC. As the view would change from the AFAC, the 16 models displayed would also change.

Recommendation: Due to the limitations of the technology at this point in time, careful analysis should be performed to construct the scenarios and adjust simulation prioritization schemes so that the most tactically significant entities are visible to each player on the battlefield. This analysis needs to be done at a very early stage of the system integration process.

2.2.4.3 Vulnerability

Issue: The effects of any engagement should parallel real life.

Discussion: Due to some technology limitations (in this case, a DIS translating problem), the ZSU-23s firing had no effect on the AFAC, making it invulnerable. This did not allow for a realistic fight. The impact on the CAS tactics of the participants was great. The AFAC did not report the fire, did not leave the area, did not get killed, and did not call for a Suppression of Enemy Air Defense (SEAD) mission or other support.

Recommendation: A work-around might have been to have the O/Cs announce to the OV-10 whenever the ZSU engaged him, noting the location and type of fire and effects. When

discrepancies in vulnerability occur and a work-around solution cannot be found, elimination of one of the entities may be the answer. The point here, again, is that early in the system integration process, the operational impacts of technology limitations must be identified.

2.2.5 Congruence of X, Y, Z location

Issue: Entities on and features of the terrain database should have consistent x, y, z locations.

Discussion: Due to the discontinuity of the terrain databases at the different sites, the entities positioned at one site, e.g. Ft Knox, may appear to be floating above ground or positioned underground at another site. In addition, planes flying at the Armstrong site close to ground level may appear to fly underground at Ft. Knox. The disparity appears to be due to the differences in the "y" axis of the terrain databases. The situation also applies to air-dropped bombs and marking rockets (sometimes they exploded "underground") and makes the interaction between controlling agencies at the various sites very difficult.

Recommendation: A method of referencing entities to the ground (y = o) has been developed called "ground clamping". This allows ground vehicles to appear on the ground at each site. It also kept marking rounds and bombs from detonating underground (although in the case of bombs, it produced bizarre visual effects at Ft. Knox - flaming bombs skidding along the ground). This methodology could not be applied to the planes flying; however, "flying through hills" was corrected by keeping the AFAC at a slightly higher altitude. It is essential that the views at each site in this exercise be consistent. An analysis should be performed in the preparation stages of an exercise by putting each participating moving model (to include ordnance impacts) out in the terrain, observing it from all systems and comparing appearances/ location data.

2.2.6 Local Communications

2.2.6.1 Tactical

Issue: Communications between players within a site should be consistent with the normal communication lines available to troops in a comparable real tactical situation.

Discussion: The site with the greatest number of players and with the need for local communications was Ft. Knox. There were 5 M1A1 tank simulators, 2 Bradley simulators, a simulated TOC and the stealth station. Initially, the Air Liaison Officer (ALO) and Fire Support Officer (FSO) had been placed in an M1A1 simulator with one radio operating three radio nets. The function of these two positions require that they operate two radios simultaneously. This was not feasible with the current configuration in this simulator, so a TA312 field phone was wired into the simulator to allow conversation with the TOC. This communication problem and the simulator assignment issues, section 2.3.4.4, were both solved by putting the ALO in the TOC; the Enlisted Terminal Attack Controller (ETAC) replaced the ALO in the tank, the FSO went to the TOC during the Offense scenario and went to a different

tank from the ALO during the Defense scenario. In addition, the scouts in the two Bradleys felt they needed their own internal net to communicate with each other during the defensive scenario. The decision was made that they would communicate on the Fire Net. It was also felt that the information coming to the TOC across the intel net was weak. This was not purely a communication problem, however, the solution was to set up a CB radio from the stealth station so that proper intel could be communicated.

Recommendation: Careful pre-exercise analysis should be performed to determine the local tactical communication needs based on the scenarios used and the functions of the troops during the course of each scenario. Simulator assignments and upgrades (temporary or permanent) to simulators can be made accordingly.

2.2.6.2 Technical/Administrative

Issue: The status of the exercise participants should be provided to the Observer/Controller (O/C), Technical and Administrative staff.

Discussion: During the course of the exercise, there was often confusion as to the status of the network, of various simulators and of the SAF.

Recommendation: It is recommended that a real-time status information display be set up at the stealth station, easily visible to the O/Cs, that shows which simulators are up and which other sites are connected.

2.2.7 Long Haul Communication

2.2.7.1 Tactical

Issue: Bandwidth requirements for tactical voice traffic should be determined in the planning stages of an exercise.

Discussion: The tactical requirements drive the volume of voice communications across the long haul network. Peak bandwidth requirements can crash the net if enough bandwidth has not been allocated. (See Issue 2.2.2.2)

Recommendation: Estimate peak voice traffic demands based on the tactical scenarios, prior to requesting bandwidth allocations.

2.2.7.2 Technical/Administrative

Issue: Communication lines between O/Cs should be direct and separate from tactical, technical staff, and other communications. Technical staff at all sites should also have a separate communications line

Discussion: During the first week of this exercise, the only communication line between the controllers at all the sites was via the DSI network. When the DSI net was down at one or more sites no work-arounds could be arranged because O/C communication was down. The decision

was made to have commercial phones placed at the O/Cs station at each site and to try to maintain an open phone line between them. This was accomplished during the second week of the exercise.

Recommendation: Since communication between O/Cs, and between technical personnel should not interfere with the tactical conduct of an exercise, separate communication lines should always be installed. These should not use the DSI network. ATT Conference Calls seem to be a reasonably cost-effective approach to this requirement.

2.3 TRAINING/SCENARIOS

2.3.1 Troop Training

Issue: Troops must be simulator-trained and position-trained prior to being used in an exercise which focuses on evaluating tactical training tools.

Discussion: All the troops present at the Ft. Knox site had previous expe with simulation. Our belief is, however, that this was the luck of the draw. No familian n class for the simulators had been scheduled; it probably should have been..

The troops assigned to one of the two Bradleys were instructed to operate the Bradley as if it were a Fire Support Team (FIST). They were not, however, tactically trained as a FIST.

Recommendation: Troops should be placed in the positions and vehicles for which they are trained. If they are not sufficiently trained, this may affect the results of the exercise and the evaluation of the training system. Some time should always be allotted for simulator training.

2.3.2 AAR

2.3.2.1 Visualization and Display Tools (Stealth, PVD, SIMNET 6.6.1 Datalogger)

Issue: The use of display tools and the visualization of the exercise should be maximized during the preparation and conduct of an AAR.

Discussion: TOC Plan View Display:

A plan view display was placed in the TOC area (not visible to participants) to be used for AAR. The plan was to have the O/Cs request snapshots from the operator of key events during the course of each exercise run. These snapshots would aid in discussions of the runs. Very few, if any, requests were made during the first few days of the exercise. Col. Elder revised the task so that the Plan View operator would capture a snap-shot every half hour during the run and additional snap-shots as requested directly from Col. Elder. These snapshots were finally utilized for the first formal AAR on Thursday, May 12th and were used more extensively thereafter. A replay of the exercises on the plan view display at the stealth station, coordinated (by "time hack") with similar displays at the other sites, was used throughout the AARs during the second week of the exercise.

Stealth Station/Datalogger:

The SIMNET 6.6.1 Datalogger has the capability of capturing an entire exercise and replaying it through the network. It can be viewed at any station on the network equipped with a CIG and/or Planned View Display (PVD). Due to the technical difficulties encountered during the preparation week for the exercise, only a limited AAR was performed and the stealth station was not used. The O/Cs did take advantage of this tool during the actual exercise (second week), and key parts of the scenarios were replayed and used during each AAR.

Recommendation: The tools available to capture the events of each exercise are very valuable for AARs and their use should be maximized. The plan view display allows the user to move through time at variable speeds and focus on key events during the course of the exercise. These key time frames can then be viewed from any point in space through the use of the stealth station. The snapshots taken on the PVD during the course of the exercise would help to pinpoint these key events.

Use of a PDU transmitted from one stealth station to control the point-of-view of other stealths (or simulator visuals) has been demonstrated. Allowing Col. Elder to direct the entire distributed AAR audience's point-of-view of a particular event in this way would have been useful.

2.3.2.2 Unit Performance Assessment System (UPAS)

Issue: Data captured through the collection tools of UPAS was used, but the system's capabilities were under-utilized.

Discussion: UPAS data were perused after the exercise, but not incorporated in the AAR during the first week of the exercise. During the second week of the exercise, fire and kill data were provided to Col. Elder for use during the AAR. This data included number and type of kills for each CAS mission and number and type of kills for the entire exercise of Blue and Red forces. The number of bombs dropped and the number of hits by the F16s were also presented. See Appendix D for a sample of this data. This information represented data from only two PDU packets: "Fire" and "Vehicle Status Change". Other PDU packets collected were: "Impact", "Vehicle Appearance", "Status" and "Indirect Fire". It should be noted that the lase PDU on DIS cannot be translated to SIMNET. It was therefore not available for analysis by UPAS.

The goal of UPAS is to help trainers to identify and illustrate key exercise events quickly after an exercise. The information collected by UPAS during the course of the exercise can display information in a way that supports quick interpretation by a trainer or researcher, and, at the same time, provides animated figures, static figures, and tables that can be used to illustrate key training points to exercise participants during an AAR. It can be used subsequently to support training needs analysis and research. Members of the performance measures team did not have any opportunity to work with the trainers before the exercise. Only a small segment of these tools were therefore utilized during MDT2.

The AAR information display tools available under the Data Summary menu include the following:

- Battle Flow (animated figure - assesses overall movement)
  - traces movements of vehicles on a grid map
  - can control points in time covered by a particular trace
  - can specify time interval at which vehicle positions are marked
  - can magnify a portion of the battlefield
- Battle Snapshot (shows position and gun tube orientation at specific points)
  - select points during mission
  - shows Line-of-Sight (LOS) between vehicles
- Exercise Timeline (describes events as a function of time)
  - identify key time segments
- Fire Fight (shows direct and indirect fire events over a terrain map)
  - period of time is user selectable
  - shot lines
  - miss is displayed with a white line
  - green is a hit/kill; dead vehicle icon is displayed at target location
  - artillery impacts are white rectangles
- Plan View (replays the battle or selected segments of the battle)
  - shows bird's eye view over a grid map
  - terrain features are color coded
  - can move to a selected time
  - can magnify portions of the battlefield
  - can print a hard copy at any point in time
- Screen Image File Display (AAR Presentation Manager)
  - to view saved screens which contain trainer comments

Recommendation: UPAS has many features which can be utilized, not only for AARs, but also for further analysis and evaluations. The factual data it provides may not always be apparent from the visual tools obtained through the datalogger, e.g. kill information, exact time of key events. These data can also aid in focusing in on the time frame desired for viewing at the stealth station.

The key to proper utilization of the system is to provide a timeframe for trainers, engineers and members of the performance measures team to meet and discuss the tools that are available and which of those tools can be effectively used in an AAR and for performance analysis. The way in which UPAS is used will vary according to the type of exercise run. For example, an analysis of the F16s' movements via the Battle Flow display would have been confusing if used

in this exercise, due the large number of flyovers. Most of these flyovers occurred, however, due to technical difficulties encountered such as an inability to see marking rounds, failure to get a "clear hot" in time, etc.

The only method of broadcasting UPAS displays to the various sites for use in an AAR would have to be via video teleconferencing with color monitors, since these displays are color coded. The monitors used at each site should be large enough to accommodate viewing by a group.

Future versions of UPAS are planned on a workstation for the DIS environment. This change will upgrade UPAS to a real-time system and increase its capabilities. The system will enable UPAS to be used in the course of exercise control. Current status information can be relayed to the O/Cs as needed and time markers can be input as key events occur.

2.3.3 Video Teleconferencing

Issue: All sites need VTC capability for AARs.

Discussion: The only video teleconferencing hook-up was between Ft. Knox and the Institute for Defense Analysis (IDA) facility in Alexandria, VA. There were only audio connections with the other sites. The visual displays provided by the stealth station and the plan view display greatly enhance the ability to provide an informative and productive AAR. It appeared very difficult to be effective with just the audio tools.

Recommendation: Equip all stations with VTC capability for AARs. The VTC cameras should be controlled throughout the AAR by a local operator at the presenter site rather than just lingering on one shot. The VTC would be less critical if the recommendations in section 2.3.2.1 with respect to central control of Stealth/PVD point-of-view are implemented.

2.3.4 Scenarios

2.3.4.1 Exercise Scenarios

Issue: Scenario development should support the goals of the training exercise and capitalize on the technical capabilities of the system, while avoiding "bumping into" system limits.

Discussion: The scenarios in this exercise were developed without consultation with the engineering team or input by the Chief Trainer. This resulted in the inability to perform some aspects of the scenarios, given some of the restrictions of the system, so revisions had to be made. For example, a critical technological constraint was that of the MULE's inability to see targets outside its specified 45° cone and limited to only 5 entities. The MULE's ability to see and lase targets was critical to achievement of the training goals

Recommendation:

The scenarios need to be developed in conjunction with the Chief Trainer, the engineering team and the analysis team with a focus on the goals of the training exercise and possible system

limitations. There needs to be a test of the system and the scenarios long haul to see the interaction between the scenario and the systems at each participating site. The analysis team needs to understand what measures and tools will be required during the course of the exercise.

2.3.4.2 System Test Scenarios

Issue: Small "single thread" segments of the actual scenarios should be used to perform system testing prior to any exercise.

Discussion: System testing was performed prior to the exercise preparation week without the benefit of any tactical context. Some problems were not discovered until the actual scenarios were exercised on the long-haul network. This was due to the fact that certain tactical maneuvers caused problems that technicians did not anticipate. The moving model limitations discussed above are one example, as are the target acquisition problems encountered by aircraft flying tactical profiles..

Recommendation: The positioning and movements designated in different scenarios can present their own unique problems within the system with respect to target acquisition, entity prioritization, etc. In the system testing phase of an exercise, key "threads" of each scenario must be played to identify artifacts in the system. A good approach would be to isolate key factors in the scenario and test them individually, e.g. bombing flight pattern, targets available to MULE for lasing, target detections/line-of-sight evaluations, etc.

2.3.4.3 Assignment of Simulators

Issue: The assignment of the manned simulators should correlate with the training goals of the exercise.

Discussion: The simulators available for this exercise at Ft. Knox included the following: 5 M1A1 tanks, 2 Bradleys and a baseline TOC. The original configuration for this exercise designated two of the tanks as platoon leader vehicles and placed the FSO and ALO in the same tank. During the course of the exercise, it was found that since the CAS functions being trained did not go down to the platoon level, this configuration of simulators was not the most effective. In addition, two key players, the FSO and ALO had to share a radio. Midway through the preparation week, the assignment of simulators was changed to a more suitable configuration for each type of scenario as represented in Table 2.3.4.3-1 and Table 2.3.4.3-2.

Table 2.3.4.3-1 Defense Simulator Assignments

DEFENSE		
TANK	BRADLEY	TOC
TF CDR TF ETAC TF FSO TM CDR TM XO	SCT PLT LDR TM FIST	ALO

Table 2.3.4.3-2 Offense Simulator Assignments

OFFENSE		
TANK	BRADLEY	TOC
TF CDR TF ETAC 1st SGT TM CDR TM XO	SCT PLT LDR TM FIST	ALO FSO

The ALO operated from the TOC and the FSO and ETAC were placed in separate tanks for the defensive scenario. The FSO also operated from the TOC during the offensive scenario leaving a tank available for one platoon leader. The other platoon leaders were run through SAF and a Team (TM) Executive Officer (XO) operated in his own tank. The FIST now functioned as a scout and traveled with the other scout vehicle.

Recommendation: The assignment of manned simulators should be planned with the Chief Trainer to optimize the type of training sought. The manned positions should be the players who are actively involved in the exercise.

2.3.5 Read-Ahead Materials

There seems to have been sufficient and comprehensive read-ahead materials provided in advance of the exercise.

3 BDS-D EXIT CRITERIA

During the course of the MDT2 exercise, the following BDS-D Exit Criteria were demonstrated:

1. Dissimilar Sims: The simulators used in this exercise at Ft. Knox are SIMNET and designed to function across the network whereas the simulators at the other three sites (Pax River, NRaD and Armstrong Labs) were not originally designed to be networked and presented a mixed fidelity. The results were a relatively successful integration of the different systems.

2. Wide Area Network (WAN): Two of the sites participating in MDT2, Armstrong and Ft. Knox, used different Local Area Networks (LANs) and were successfully connected on the WAN to the other two nodes, Pax River and NRaD, who did not use a LAN. In addition, these sites used three different interface units: NIU at NRaD and Armstrong, AIU at Pax River, and SIMNET Protocol Translator at Ft. Knox.

3. Secure Network: This exercise was conducted entirely over the secure DSI network.

4. DIS 1.0: The enhanced goal for DIS in 1994 is DIS 2.0. MDT2 achieved DIS 2.03.

It should be noted that MDT2 was not designated as a demonstration vehicle of BDS-D Advanced Technology Demonstration (ATD) architecture. It did, however, fulfill several criteria in the course of the achieving its own goal, which was to use DIS to conduct meaningful multi-service, combat mission training.

4 SUMMARY AND CONCLUSIONS

The main programmatic lesson learned in the MDT2 exercise can be summed up as follows:

(1) There is a need to carefully analyze the goals of joint training exercises, the technical capabilities of the systems which will be used through the Distributed Interactive Simulation network and the Performance Measures sought. *All the components of the exercise should be viewed as part of one system and the effort to integrate and employ them should be led by one individual, as project leader.* See Figure 4-1.

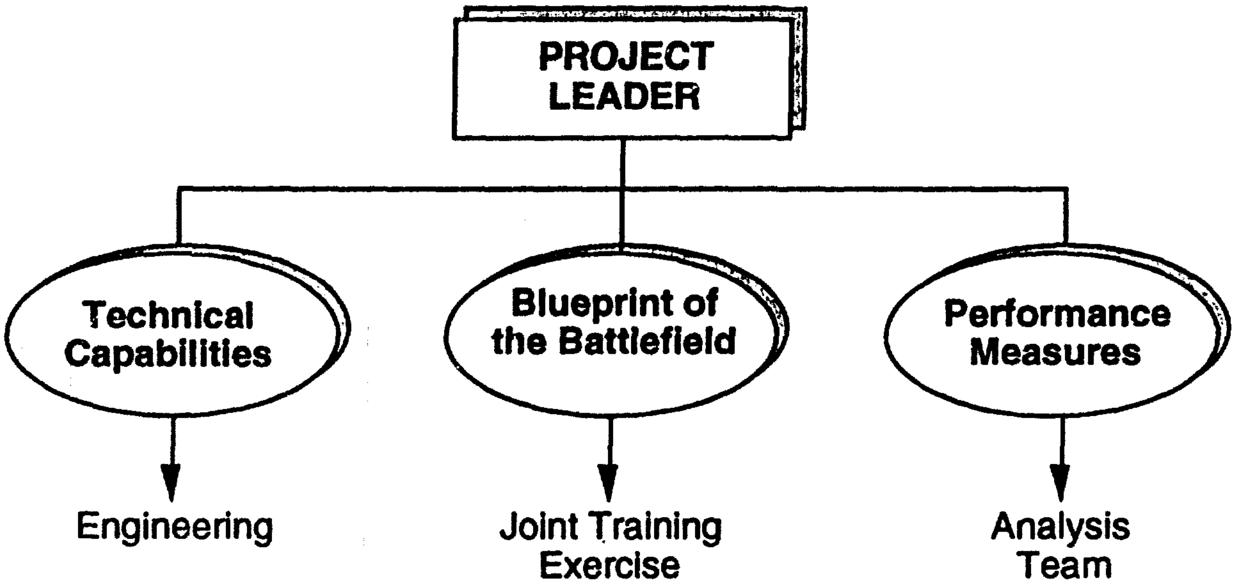

Figure 4-1 System View

Figure 4-2 shows the process involved in successfully integrating these components. The technical capabilities must be compared with the behavioral goals sought and integrated with the performance measures desired.

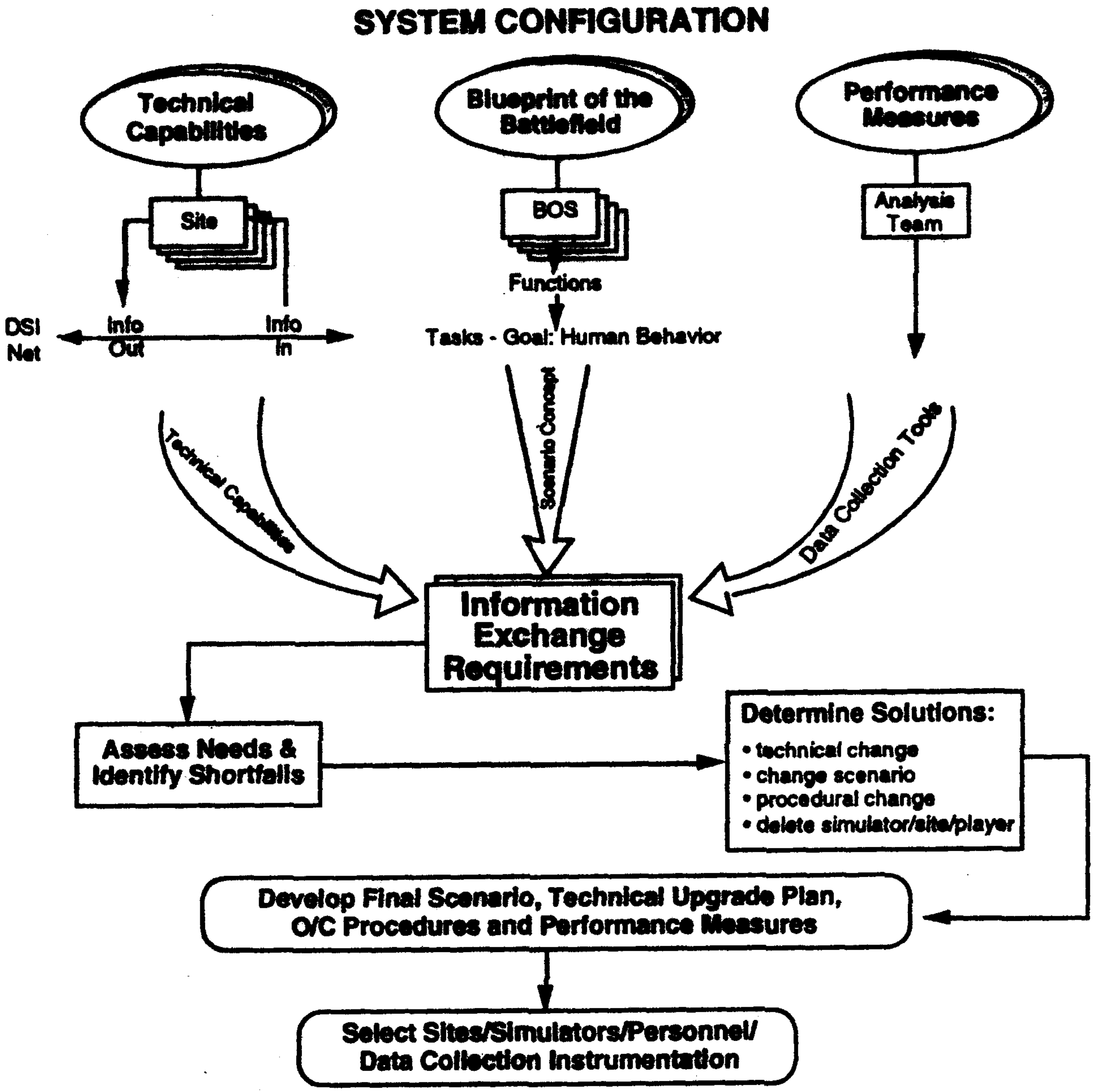

Figure 4-2 System Configuration

The technical information which is brought to the "Information Exchange" box should permit an in-depth analysis of the technical capabilities of each proposed site to support the exercise. Figure 4-3 lists the categories of information that participating simulations. are capable of sending and receiving.

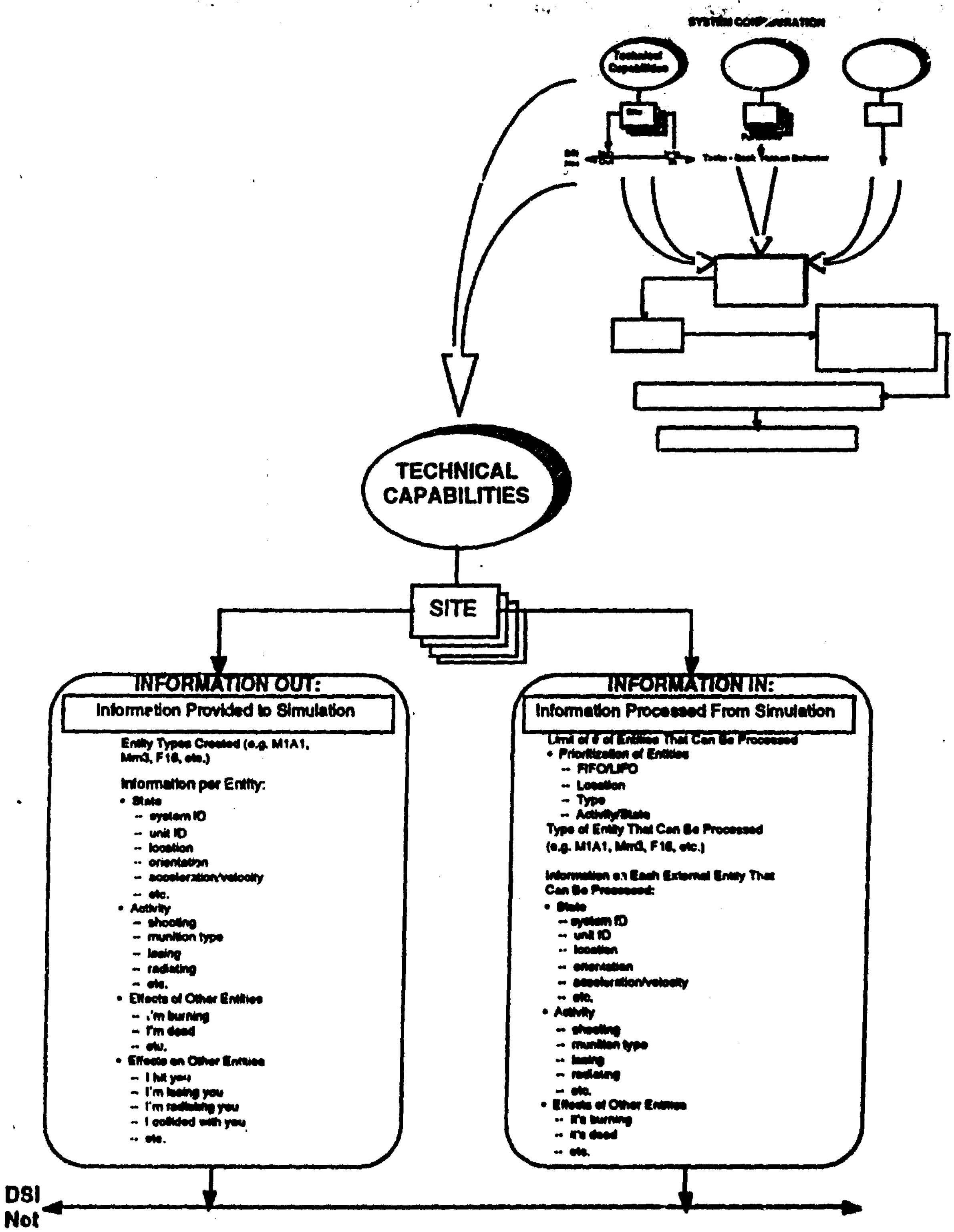

Figure 4-3 Technical Capabilities

Any simulated entity (entity "A") on the virtual battlefield, sends information about itself out to the network. In addition, information about the other entities on the battlefield that can be processed by entity "A" are sent in from the network. A detailed list of this information for every entity type involved in the exercise should be developed. A systematic analysis of "information out" and "information in" should be performed for every site so that a summary of technical capabilities available for the exercise can be compiled.

This compilation should be analyzed by the senior technical, training and performance analysis teams to assess the system capabilities, map them against operational requirements, and identify the shortfalls which may exist. The solutions to system shortcomings required may fall into a number of different categories. There may be a feasible technical solution available to solve a training requirement. If not, a slight alteration in the scenario (e.g. assuring the Red vehicle pass through the cone of visibility for the MULE) may solve a problem. There may also be many work-arounds involving procedural changes (O/C can provide necessary information not available through the simulation). Finally, there may be a necessity to eliminate a simulator, a particular player or even a site if there is no other solution and the inclusion of any one of these interferes with the exercise.

(2) To ensure that this system level approach is executed, the project leader (we would have nominated Col. Elder in this case) must be given the mission, time and resources to put together the system, the scenario, and the training while integrating the technical elements and analysis requirements. Coordination and planning is key to the project's success.

APPENDIX A: ACRONYM LIST

A/A ....Anti-Aircraft
A/L ....Administration/Logistics
AAR ....After Action Review
ADA ....Air Defense Artillery
AFAC ....Airborne Forward Air Controller
AFSC ....US Air Force Armstrong Laboratory
AIU ....Adapter Interface Unit
ALO ....Air Liaison Officer
ARI ....US Army Research Institute for the Behavioral & Social Sciences
ARNG ....Army National Guard
ARPA ....Advanced Research Projects Agency (formerly DARPA – Defense Advanced Research Projects Agency)
ARTEP ....Army Training and Evaluation Plan
ATD ....Advanced Technology Demonstration
BBN ....Bolt, Beranek, and Newman
BDA ....Battle Damage Assessment
Bde or BDE ....Brigade
BDS-D ....Battlefield Distributed Simulation - Developmental
BFV ....Bradley Fighting Vehicle (M2 or M3)
BLUFOR ....Blue Forces
Bn or BN ....Battalion
BOS ....Battlefield Operating System
C^2 ....Command and Control
CADIS ....Computer Architecture for Distributed Interactive Simulation
CAS ....Close Air Support
CAS/BAI ....Close Air Support/Battlefield Area Interdiction
CATS ....Combined Arms Training Strategy
CDR ....Commander
CIG ....Computer Image Generator
CO ....Commanding Officer or Commander
COL ....Colonel (O6)
CPU ....Central Processing Unit

CRT............................Cathode Ray Tube (display)

DED............................Data Element Dictionary

DFO............................Deployable Forward Observer

DIS.............................Distributed Interactive Simulation

DMSO........................Defense Modeling and Simulation Office

DSI.............................Defense Simulation Internet (uses the DIS protocols)

ETAC.........................Enlisted Terminal Attack Controller

FAC............................Forward Air Controller

FIST...........................Fire Support Team

FIST-V.......................Fire Support Team Vehicle

FLOT..........................Forward Line of Troops

FOV............................Field-of-View

FSE.............................Fire Support Element

FSE.............................Forward Security Element

FSO............................Fire Support Officer

HMD..........................Helmet-Mounted Display (or Head Mounted Display)

HumRRO...................Human Resources Research Organization

IDA.............................Institute for Defense Analysis

II.................................Illusion, Inc.

LAN............................Local Area Network

LDN............................Local Data Network

LHN............................Long Haul Network

LOS.............................Line-of-Sight

M1A1.........................Abrams Main Battle Tank (120 mm main gun)

M2..............................Bradley Infantry Fighting Vehicle (IFV)

M3..............................Bradley Cavalry Fighting Vehicle (CFV)

MAJ............................Major (O4)

MBAG........................Main Body of the Advance Guard

MDT2.........................Multi-service Distributed Training Testbed

MLRS.........................Multiple Launcher Rocker System

MULE.........................Marine Ground Laser Designator

MWTB........................Mounted Warfare Test Bed, Ft. Knox, KY

NTC............................Naval Training Center

NAWC/TSD...............Naval Air Warfare Center, Training Systems Division

NIU ....Network Interface Unit

NRaD ....Research, Development, Test and Evaluation Division of the Naval Command, Control and Ocean Surveillance Center, San Diego, CA

O/C ....Observer/Controller

OP ....Observation Post

OPFOR ....Opposing Forces

OPORD ....Operations Order

OTW ....Out-The-Window

PAX ....Systems Engineering Test Directorate, Patuxant River, MD

PC ....Personal Computer

PDU ....Protocol Data Unit

PL ....Platoon Leader

Plt ....Platoon

PM ....Program Manager

POC ....Point of Contact

POSNAV ....Position Navigation

PT ....Protocol Translator

PVD ....Plan View Display

ROE ....Rules of Engagement

S-2 ....Battalion Intelligence Officer

S-3 ....Battalion Operations & Training Officer

SAF ....Semi-Automated Forces (synonymous with Computer Generated Forces)

SAFOR ....Semi-Automated Forces

SAM ....Surface to Air Missile

SCT ....Section Leader

SEAD ....Suppression of Enemy Air Defense

SIMNET ....Simulation Network

SINCGARS ....Single Channel Ground and Airborne Radio System

SP ....Software Problem

STARTEX ....Start Time of Exercise

STRICOM ....US Army Simulation, Training and Instrumentation Command, Orlando, FL

T-72 ....Tank (Soviet)

TACP ....Tactical Air Control Party

TC..............................Tank Commander (in M1) or Track Commander (in M2/3)

TF..............................Task Force

TM..............................Team Leader

TOC............................Tactical Operations Center

TOW ....Tube launched, Optically tracked, Wire guided (missile)

UPAS ....Unit Performance Assessment System

V&V............................Verification and Validation

VTC............................Video Teleconference

WAN...........................Wide Area Network

WDL ....Western Development Laboratories (a Loral Company)

WP ....White Phosphorus

XO..............................Executive Officer

APPENDIX B: FORT KNOX PARTICIPANTS

Senior Observer/Controllers/Trainers:

- COL Don Elder, Army, Senior Trainer
- Jim Love, Assistant
- COL Mike Rodriguez, Air Force, Air Trainer
- Major Mark McKeon, Marines, Assistant
- Paul Jerett, Assistant, HUMRRO

Researchers/Data Compilers:

- Dan Dwyer, NAWC/TSD
- Larry Meliza, USARI Orlando
- Angelo Mirabella, ARI
- Seng Tan, Institute for Simulation and Training
- Joyce Madden, NAWC/TSD
- Larry Rieger, US Army Training Support Center

Technical:

- Steve Farrow, LORAL, ADST PMO

APPENDIX C: DR. MOSES DSI MEMO

PERI-II 16 May 1994

MEMORANDUM FOR THE RECORD

SUBJECT: Impact of DSINet on the Multi-Service Distributed Training Testbed (MDT2)

1. During the week of 9 May 1994, the Multi-Service Distributed Training Testbed (MDT2) used the Distributed Simulation Internet (DSINet) for preliminary tests of its capability to support training of Close Air Support. This is part of the four-Service project, supported by the Defense Modeling and Simulation Office (DMSO), to demonstrate the value that distributed simulation can add to joint training. While the DSINet could be a good asset, its reliability was disappointing.

a. DMSO and ARPA proponents of the MDT2 proposal said in November 1992 that the DSINet was capable of supporting such multi-point distributed training requirements. My current data do not support that claim.

b. Explanations for poor network reliability are unclear as I write this memo. MDT2 is conducting engineering tests this week to try and isolate the problems. All network contractors including BBN and Houston Associates are cooperating within the constraints of their contracts.

2. We required a multi-point connection of four sites with a total of only 60 moving entities and four channels of digital voice. Eleven simulators were connected among the sites. MDT2 scheduled nine hours per day for four days on the DSINet. Network availability was unpredictable and materialized for only about 60 percent of the scheduled 36 hours. The problems occurred even though the network was not heavily loaded. Little to no training could be accomplished with the DSINet's performance.

3. MDT2 will proceed with its scheduled training exercise during the week of 23 May 1994. All participants express enthusiasm for its potential and hope for its success. The training requires network time from 0800 to 1800 each of the five days to allow connectivity tests, training exercises, data collection/analyses, and After Action Reviews.

a. On 24 May 1994, the Marines and MDT2 simultaneously plan multi-point use of different parts of the DSINet. The Marines have scheduled a demonstration of the technology for general officers and other high ranking officials. MDT2 invited Congressional observers, senior personnel from the services and from OSD to see training from a node at the Institute for Defense Analyses, Alexandria, VA. The network engineers say that the system is designed for

such dual use if it is working and properly initialized, but there seem to be frequent initialization problems.

b. Another concern is that network performance during almost two months before last week was not even 60 percent reliable. Contractors who operate the network and users experienced with it tell me that reliability for tests always is better than during preparations when the need is less critical.

4. It appears that the technology currently in use by the DSINet is not capable of routinely supporting MDT2's multi-point training application. However, the technology will never be ready unless MDT2 and similar projects continue to test its capabilities and thereby foster better performance.

a. So far, the network well supports technology demonstrations as a primary focus. Those demonstrations can work less than perfectly and still be successful. In a training application, the participants need to focus on the training objectives without distractions from network problems.

b. MDT2 faces the unexpected challenge of pushing network technology in support of a training goal in addition to testing the value of distributed simulation for training. Why is the net not as ready as advertised? ~~I hope that I can better answer that question after more experience next week and during the MDT2's scheduled Phase 2 starting in July 1994.~~ Delete

LTC. Dramczuk STRICOM
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DUSA(OR), Mr Walter Hollis
AMSMO, COL David Hardin
MDT2 Task Leaders

Joint Program office
Jill Avery; STO office

Dr. Randy Garrett, IDA
Mr Johnny Harper, Hawkins Associates
Dr. ~~Mr.~~ Robert Tanner, BBN

APPENDIX D: UPAS DATA

LOG OF F16 FIRING EVENTS

TIME	FIRER ID	FIRER LPN	RESULT	LOCATION	AMMO
12:52:49		14.4.6	K	N5856K0368	US GBU10 B
12:53:23		14.2.6	H	N5857K0369	US GBU10 B
12:54:54		14.2.6	M	N5856K0369	US GBU10 B
13:10:44		14.2.6	M	N5691K0359	US GBU10 B
13:28:08		14.4.6	H	N5479K0147	US GBU10 B
13:28:08		14.4.6	H	N5479K0147	US GBU10 B
13:30:12		14.2.6	K	N5505K0193	US GBU10 B
13:30:12		14.2.6	H	N5505K0193	US GBU10 B
13:30:41		14.4.6	M	N5514K0213	US GBU10 B
13:43:59		14.4.6	M	N5550K0272	US GBU10 B

LOG OF F16 HITS/KILLS

TIME	FIRER ID	FIRER LPN	RESULT	TARGET TYPE
12:52:49		14.4.6	K	USSR T72M
12:53:23		14.2.6	H	USSR T72M
13:28:08		14.4.6	H	USSR BMP2
13:28:08		14.4.6	H	USSR BMP2
13:30:12		14.2.6	K	USSR BMP2
13:30:12		14.2.6	H	USSR BMP2

FIRES OVER TIME (NO ADA)

TIME	FIRING SIDE	FIRING WEAPON	RESULT	FIRER ID	TARGET ID
12:50:51	B	US F16C	M		
12:51:19	B	US F16C	H		
12:53:01	B	US F16C	H		
12:54:26	B	US F16C	K		
12:55:50	B	US F16C	K		
12:57:58	B	US F16C	K		
12:68:16	B	US F16C	M		
13:07:24	B	US M2	K	M71	
13:22:57	R	USSR BMP2	H		
13:22:59	R	USSR T72M	H		
13:22:59	R	USSR T72M	K		
13:23:00	R	USSR BMP2	H		
13:23:01	R	USSR BMP2	H		
13:25:15	B	US F16C	H		
13:28:45	B	US A10	M	PAX-OV10	
13:29:50	B	US A10	M	PAX-OV10	
13:30:30	B	US F16C	H		
13:34:27	B	US M1	M	H66	
13:34:40	B	US M1	M	H66	
13:34:47	B	US M2	K	A12	
13:34:49	B	US M2	H	A12	
13:34:55	B	US M2	H	A14	
13:34:55	B	US M2	K	A11	
13:34:57	B	US M2	H	A12	
13:34:57	B	US M2	H	A14	
13:34:57	B	US M2	K	A11	
13:34:59	B	US M2	H	A12	
13:36:03	R	USSR BMP2	K		A11
13:35:10	R	USSR BMP2	H		A11
13:35:13	B	US M1	M	H65	
13:35:18	B	US M1	M	A65	
13:35:26	R	USSR T72M	K		A14
13:35:27	B	US M1	M	A65	
13:35:30	R	USSR T72M	M		
13:35:37	R	USSR T72M	M		
13:35:38	R	USSR T72M	K		A12
13:35:40	B	US M1	K	A65	
13:35:40	R	USSR T72M	H		A12
13:35:42	R	USSR T72M	M		
13:35:46	B	US M1	M	H66	
13:35:54	B	US M2	M	H71	
13:35:55	B	US M1	M	A65	
13:36:06	B	US M1	M	H66	
13:36:17	B	US M1	M	A65	
13:36:19	B	US M1	H	A31	
13:36:24	B	US M1	K	A31	
13:36:24	B	US M1	K	A34	
13:36:25	B	US M1	H	A32	
13:36:25	B	US M1	H	A33	
13:36:25	B	US M1	M	H65	
13:36:31	B	US M1	K	A33	
13:36:31	B	US M1	M	A34	
13:36:32	B	US M1	H	A32	
13:36:32	B	US M1	M	A65	
13:36:33	B	US M1	K	A31	
13:36:33	B	US M1	M	H65	

HIT/KILLS BY FIRING SIDE,WEAPON TYPE

SIDE	WEAPON SYSTEM	# HITS OR KILLS
B	US A10	0
B	US F16C	9
B	US M1	14
B	US M2	4
R	USSR BMP2	3
R	USSR T72M	5
R	USSR ZSU23_4M	1

CASUALTIES SUSTAINED (HIT OR KILLED)

SIDE	TARGET VEHICLE TYPE	CASUALTIES
B	US A10	1
B	US M1	3
B	US M2	3
R	USSR BMP2	10
R	USSR T72M	8
R	USSR ZSU23_4M	2

FIRES OVER TIME (NO ADA)

TIME	FIRING SIDE	FIRING WEAPON	RESULT	FIRER ID	TARGET ID
13:36:43	B	US M1	H	A31	ADA-1
13:36:43	B	US M1	H	A34	ADA-1
13:37:02	B	US M1	M	H65	
13:37:03	B	US M1	M	A65	
13:37:16	B	US M1	M	A65	
13:37:34	B	US M1	M	A65	
13:37:35	B	US M1	M	H66	
13:37:53	B	US M1	M	H66	
13:38:07	B	US M1	M	H66	
13:38:18	B	US M1	M	H65	
13:38:27	B	US M1	H	H65	ADA-1
13:38:30	B	US M1	K	A31	
13:38:36	B	US M1	K	A33	
13:38:36	B	US M1	K	A34	
13:38:36	B	US M1	M	A65	
13:38:37	R	USSR BMP2	H		H65
13:38:39	B	US M1	H	A31	
13:38:43	R	USSR BMP2	K		H65
13:38:45	B	US M1	M	A65	
13:39:05	B	US M1	K	A65	ADA-2
13:39:17	B	US M1	M	A65	
13:41:23	B	US M1	H	A21	
13:41:28	B	US M1	K	A33	
13:41:28	R	USSR T72M	K		A34
13:41:29	B	US M1	H	A21	
13:41:33	B	US M1	K	A31	
13:41:33	B	US M1	M	H66	
13:41:34	B	US M1	H	A21	
13:41:34	B	US M1	H	A33	
13:41:37	R	USSR T72M	K		A31
13:41:37	R	USSR T72M	M		
13:41:40	B	US M1	H	A21	
13:41:40	B	US M1	K	A33	
13:41:41	B	US M1	M	H66	
13:41:45	B	US M1	K	A32	
13:41:46	B	US M1	H	A33	
13:46:20	B	US M1	M	A65	
13:46:31	B	US M1	M	A65	
13:46:41	B	US M1	M	A65	